

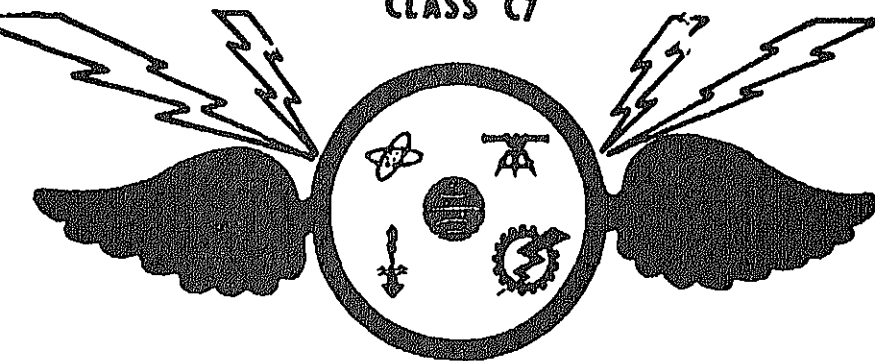
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TRAINEE WORKBOOK

FOR

AVIONICS INTERMEDIATE COURSE

CLASS C7



UNIT XII

CNTT-M1859 Rev. 3/84

PREPARED BY
NAVAL AIR TECHNICAL TRAINING CENTER
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MILLINGTON, TENNESSEE

PREPARED FOR

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12.1.1S	STUDENT ACTIVITY GUIDE
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12.14.1J	JOB SHEET
	TROUBLESHOOTING THE 11D13 T

Given a list of statements concerning the functions of the Major 11D13 Radar Units, and a list of the names of the Major Units, match the unit name to its function.

Given a list of statements of characteristics of the 11D13 operating modes and a list of mode names, match the names to their characteristics.

Given a drawing of the Radar Display, match each element with its proper name. Do this for the

- a. PPI Search Mode
- b. Bomb Director Mode
- c. Fire Control Search Sub-mode
- d. Fire Control Track Sub-mode
- e. Fire Control Breakaway Sub-mode

Given a drawing of the Radar Display and the positions of the range and range mark switches, select from the range and relative bearing of the target on the radar in either the:

- a. PPI Search Mode
- b. Fire Control Search Mode

ASSIGNMENT:

1. Information Sheet 12.1-1I, Introduction to radar.
2. NAVEDTRADEV P2974-1, Maintenance Handbook, Dec 1968, pp 3-1 through 3-73

QUESTIONS: NONE

FORMATION:

TRAINING USAGE

1. The RMT-FC3 is a classroom demonstrator intended for use of operational equipment for training purposes. It bridges the "bread-board circuitry" of basic principles and the functional systems of operational radar.
2. In conjunction with classroom lectures and laboratory work, the device can be used effectively, both as a demonstrator machine, to satisfy passive and active training requirements. Its design permits a variety of vacuum tubes, semiconductor devices, and integrated circuits to be demonstrated, while multiple channels facilitate the connection of test equipment to observe individual circuit operation.

FUNCTIONAL DESCRIPTION

1. Operational capabilities of the RMT-FC3 are similar to those of normal, low-powered, pulsed radar systems operating in the basic modes of operation--search, fire control (director (BD))--are available. The inclusion of a target generator enhances training by allowing a synthetic target to be developed in three dimensions, to be developed in each of the three dimensions. Training thus is independent of appropriate targets.
2. The two most common types of radar scope present in this equipment: plan position indication (PPI) and range-finding. The device includes the elements essential to range-finding: a transmitter, receiver, antenna, indicator, and range-finding circuits. Additional elements include track generator, and target generation units which are provided for operation in the fire-control or bomb-director mode.

up to six revolutions per minute. Manual antenna rotation is also possible from the indicator video unit or group unit. Range and azimuth data are presented and range markers are selectable in 1000-, 2000-, and 4000-yards. The B-scope is deactivated during the normal operation in the fire-control mode uses the simulated target data by the target generator unit, and involves five submodes typical of operational fire control radar systems for interceptor-type aircraft. These submodes permit the target to be initially detected, manually tracked and acquired, automatically tracked to the breakaway range (1000 yards), and data in the three possible operating ranges (0 to 1000, 1000 to 80,000 yards) are presented by the PPI display and B-scope display on the indicator display unit. The B-scope is a dual-gun design which, in addition to its normal plotting function, steering data by means of an attack display.

In operation the bomb-director mode covers the same range as in the fire-control mode. Aiming data are presented on the B-scope displays which are automatically altered from the fire-control configuration to provide expanded sweeps. The B-scope is a depressed-center sector scan at twice the scale of the fire-control mode; and the B-scope reflects the target area at the same scale of the PPI. Both indicators include control knobs for azimuth strobes which act as cross-hairs to facilitate aiming.

Each of the trainer units poses typical radar features which are built into the device to facilitate training. These features include antenna design, correct focus detail, rotary-joint design, generation of lobe patterns, coaxial-to-waveguide conversion, pulse generation using magnetrons, a dummy load antenna, transmitter load in lieu of the antenna, modulation control, a discharge device, trigger generation from free-running oscillators; synchronization of free-running relays, synchronization of free-running oscillators with the target generator, overload control circuits which actuate relays to protect the relays, and microswitch interlock protection to prevent the application of high voltages to exposed, critical parts of the device.

Throughout the device, small electrical components are mounted on removable component boards equipped with electrical quick-disconnect units. This technique permits the components to be rendered operative or inoperative by simply removing or inserting malfunctioned component boards. These malfunctioned boards contain deliberately inserted defective components for the training phase of the training program. This manner of operation is typical of the training phase of the training program.

troubleshooting curriculum with a gradually increasing degree of complexity. This concept permits teaching maintenance procedures in a logical and progressive manner to achieve the desired level of trainee proficiency.

PHYSICAL DESCRIPTION

The RMT-FC3 consists of a double rack cabinet, portability. The cabinet is 22 inches deep by 42½ inches high, and weighs approximately 1000 pounds. When assembly removed, it may be rolled through standard doorways.

The trainer incorporates design improvements resulting from field use of the previous model RMT-FC1 (Device). These improvements are:

a. Target Generator:

(1) A new, greatly simplified target generator has been developed which utilizes completely solid state design and the use of commercially available integrated circuits.

(2) The new system reduces equipment complexity and provides a more versatile tool for the radar instructor. It provides direct control of the important parameters required to demonstrate radar tracking. There is no need for the instructor to convert simulated target flight to desired bearing and elevation rate.

(3) Direction Coupler - The coupling has been improved to 12 db. This will permit utilization of the T-1000.

(4) Various other circuits have been changed to improve reliability and reliability.

re 10 db maximum
 SY 30 megahertz
 4.0 megahertz

ATION

adar Automatic: 6 rpm clockwise
 Manual Slew: zero to 6
 rpm either direction
 Manual Position: 360°

ontrol Search: 60 degree sector,
 2-bar scan. Sector center
 adjustable, ±45 degrees.
 Antenna sod of 6 degrees.
 Searchlight: 130 degrees
 Tracking: ±10 degrees/
 second minimum

ector Automatic 60 degree
 centered sector scan

tion Pitch: ±45 degrees
 Roll: 115 degrees

117-volt, 60-Hz single
 phase, AC

Track

Bomb Director

RANGES

Search

Fire Control/
Bomb Director

RANGE TRACKING

Speed

Range

TARGET GENERATOR

Range

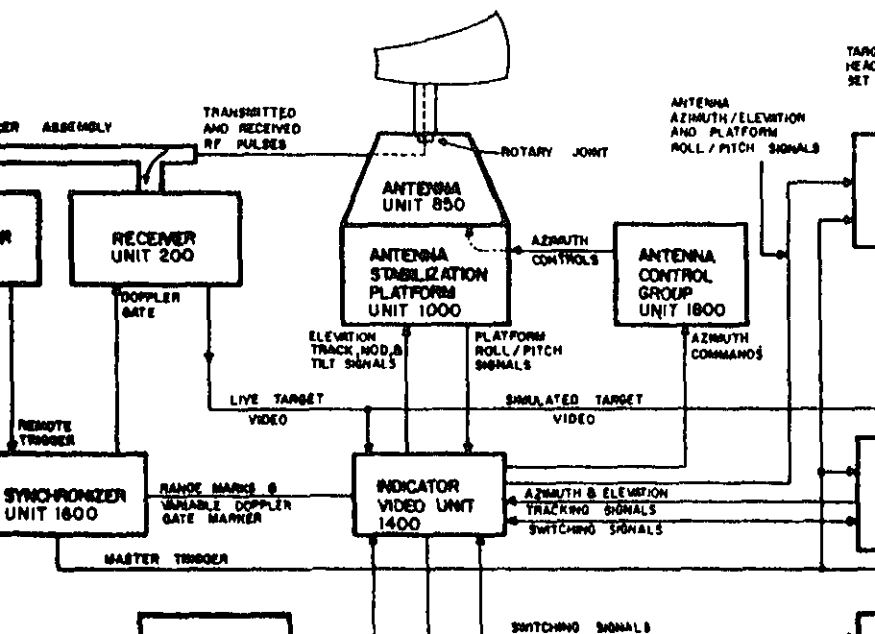
Bearing

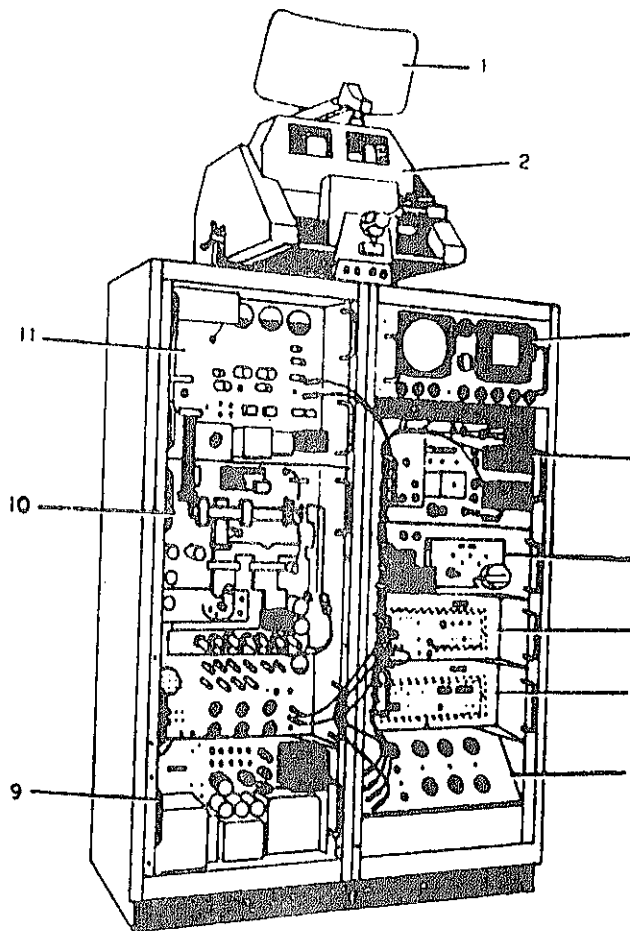
Elevation

Range Rate

Bearing Rate

Elevation Rate





- | | |
|---|--|
| 1. ANTENNA UNIT 850 | 7. RANGE TRACKING UNIT 1000 |
| 2. ANTENNA STABILIZATION PLATFORM UNIT 1000 | 8. TARGET GENERATOR UNIT 1000 |
| 3. INDICATOR DISPLAY UNIT 1500 | 9. INDICATOR POWER UNIT 1000 |
| 4. INDICATOR VIDEO UNIT 1400 | 10. RECEIVER/DUPLEXER UNIT 200/300/900 |
| 5. ANTENNA CONTROL GROUP UNIT 1800 | 11. TRANSMITTER UNIT 1000 |
| 6. SYNCHRONIZER UNIT 600 | |

BASIC FIRE CONTROL RADAR MAINTENANCE TRAINING
DEVICE 11D13A

Following list of major units of the IIBIS trainer:

Ionizer	_____	generates range strobe, amplifies target video and tracks the target.
Transmitter	_____	serves as interconnecting unit between the trainer and provides range control signals.
Receiver	_____	amplifies and detects target return pulses.
Range Indicator Supply	_____	establishes time zero and develops all timing signals for the range indicator.
Range Indicator Unit	_____	transmits r-f energy and acquires target returns.
Range Indicator Display Unit	_____	develops a high frequency, high power burst of r-f energy.
Range Indicator Track	_____	provides visual presentation of target operator and necessary signals to the fire control displays.
Range Indicator	_____	supplies operating potential to the Indicator Video Unit.

The following list of operating modes of the IIBIS trainer characteristics:

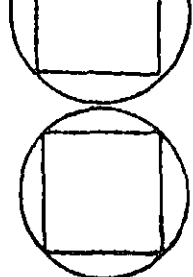
Search	_____	has five submodes and three subsubmodes.
Director	_____	rotating centered sweep with fixed and variable range markers.
Control	_____	modified, depressed center with range cursor and three subsubmodes.

trainer display for the appropriate mode/submode (label each waveform component)

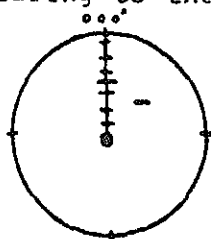
Search



e. Fire Control Breakaway



4. Using the below drawings, label for each mode relative bearing to the target.



PPI Search

Range Switch-12,000 yds

Range Marks-2,000 yds

Variable Range Mark-7



F/C Search

Range Switch

Acquisition

Range Marks-

plies. The student will not trouble
11D13 power supplies, but will be
them.

SSON TOPIC LEARNING OBJECTIVES:

- 2.1 Given the 11D13 Maintenance Handbook, a list of functions and a list of components in the unit, match the functions to the components.
 - a. Half-Wave Rectifier Low Voltage Receiver Power Supply
 - b. Full-Wave Rectifier Low Voltage Receiver Power Supply
 - c. Full-Wave Bridge Rectifier Low Voltage Unit Power Supply
 - d. Vacuum Tube Regulated Power Supply in the Power Supply Unit
 - e. Transistor Regulated Power Supply in the Synchronizer Unit
 - f. Voltage-Doubler Power Supply in the Indicator Power Supply Unit
 - g. RF Voltage Amplifier Power Supply in the Power Supply Unit

- b. Full-Wave Rectifier Low Voltage Transm
Power Supply
- c. Full-Wave Bridge Rectifier Low Voltage
Transmitter Unit Power Supply
- d. Vacuum Tube Regulated Power Supply in
Indicator Power Supply Unit
- e. Transistor Regulated Power Supply in t
Synchronizer Unit
- f. Voltage-Doubler Power Supply in the In
Power Supply Unit
- g. RF Voltage Amplifier Power Supply in t
Indicator Power Supply Unit

Finance Handbook, paragraphs 3-17 through 3-20,
3-46, 3-121 through 3-124, and 3-205 through

STUDENT ACTIVITY GUIDE 12.2.1S

IONS: NONE

2. The -25-volt output will increase/decrease if down the page.
3. How is Q-1631 used?
- As a common-collector amplifier.
 - As a comparator.
 - As a common-emitter amplifier.
 - As a voltage regulator.
4. CR-1631 is a _____ -volt z
- 12.
 - 6.3.
 - 4.
 - 10.
5. Q-1631 is d-c/r-c coupled to Q-1630.
6. Which transistor is the series regulator?
- Q-1632.
 - Q-1631.
 - Q-1630.
 - Q-1628.
 - Q-1629.

7. Write a description of what would happen if t increases. (Transistor power supply, 1600 uni

Answer-

8. To increase the output of V-104, you would mo down on T-103.
- Ture
 - False
9. How long is the time delay before 115-volts e applied to T-106?

function of T-106 and T-107 is _____

e 11D13) the function of T-103 is to

ontrol peak power out of V-105.

ontrol voltage supplied to T-104.

ontrol voltage supplied to Z-101.

l the above.

in 3 of T-105 is positive, CR- _____ and C
t.

unction of C-104 and R-115 is _____

unction of R-116 and R-119 are _____

e 11D13) M-103 monitors

tput voltage of modulator power supply.

ltage supplied to Z-101.

104 cathode current.

N charge.

s the purpose of K-101? (Refer to schematic dia
54.)

erload protection for the crystal power supply.

citation hold-in.

erload protection for the full-wave power supply

erload protection for both power supplies.

s the purpose of R-723 and R-724?

eeders resistors.

urrent-limiting resistors.

opping resistors.

rovide a complete path for current.

Answer-

22. Which winding of L-702 is the primary?

- a. Pins 1 and 2.
- b. Pins 3 and 4.
- c. Pins 3 and 5.
- d. Pins 4 and 5.

23. How does L-702 step up the +350 volts that is on the plate of V-707?

Answer-

24. Where is the 4-kv output developed?

25. V-706's feedback signal is

- a. the voltage developed across R-725 smooth.
- b. the signal coupled to L-702 pins 1 and 2.
- c. RC coupled through C-719 to the cathode.
- d. coupled through C-714 and C-713 to the g.

DELETED

LESSON TOPIC LEARNING OBJECTIVES:

- 12 .4.1 Given the 11D13 Maintenance Handbook, block diagram of the synchronizer and comments concerning the functions of the the name of the block to its function.
- 12 .4.2 Given the 11D13 Maintenance Handbook a symptoms, select from a list the fault in the:
 - a. Basic Trigger Generator Circuit
 - b. Delay Trigger Circuit
 - c. Master Trigger Circuit
 - d. Range Marks Circuit
 - e. Sweep Gate Circuit
 - f. Sweep Generator Circuit
 - g. Marks Mixer Circuit

STUDY ASSIGNMENT: Read: NAVTRADEV P-2974-1 M Handbook, Device 11D1 through 3-25.

Complete: Student Activity Guide

STUDY QUESTIONS:

1. Why is it important for the sweeps on start at the same time the transmitter
2. What is the PRF of the signal from the oscillator?
3. What is the purpose of having a delayed fire the transmitter?
4. What is the output frequency of the ri oscillator?

at range separation?

at type of oscillator does Q1612 and its associated
circuitry comprise?

at type of circuit is Q1620/Q1621?

at is the purpose of Q1615?

1. What is the purpose of the synchronizer ()
2. Q-1618 and associated components comprise
 - a. free-running single-cycle blocking os
 - b. pulsed Hartley oscillator.
 - c. free-running Hartley oscillator.
 - d. triggered single-cycle blocking oscil
3. The frequency of oscillations from the ra oscillator is
 - a. 6.18 kHz.
 - b. 16.18 kHz.
 - c. 161.8 kHz.
 - d. 61.8 kHz.
4. Delay Multivibrator (Q-1606, Q-1607) prod square wave whose pulse width is adjustab to _____ microseconds.
5. The range of the VRM is controlled by pot _____.
6. The PRF of the synchronizer reference osc
 - a. 1000 kHz.
 - b. 1 MHz.
 - c. 1000 Hz.
 - d. 100 kHz.
7. The signal present at J-1612 is
 - a. negative 1 μ sec pulses occurring at
 - b. positive 1 μ sec pulses occurring at
 - c. positive 1 μ sec pulses occurring at
 - d. positive pulses variable from 2 to 6
8. In the reference oscillator, the parallel provides a path for
 - a. noise.
 - b. regenerative feedback.
 - c. degenerative feedback.
 - d. both b and c above.

- b. negative spikes.
- c. positive sawtooths.
- d. negative sawtooths.

C-1608 and R-1619 form a _____ network

- a. differentiating
- b. coupling
- c. clamping
- d. intergrating

The output of Q-1614 is a _____.

- a. positive pulse.
- b. negative pulse.
- c. positive sawtooth.
- d. negative sawtooth.

Q-1606 and Q-1607 comprise a/an _____ multivibrator.

- a. astable
- b. bi-stable
- c. monostable
- d. quasistable

The quiescent condition of Q-1606 and Q-1607 is _____, Q-1607 _____.

- a. conducting, cut off
- b. cut off, conducting
- c. conducting, conducting
- d. cut off, cut off

The quiescent condition of Q-1609 is

- a. saturated.
- b. conducting.
- c. cut off.
- d. on, then off.

During normal operation, the ringing oscillator oscillate for at least _____ μ sec every _____ μ sec.

- a. 80, 1000
- b. 6.18, 1000
- c. 12.36, 80
- d. 18.54, 1000

- as determined by
- a. 162 kHz, 81 kHz, 54 kHz, S-1602
 - b. 1 kHz, 81 kHz, 54 kHz, S-1602
 - c. 162 kHz, 81 kHz, 54 kHz, S-1604
 - d. 162 kHz, 1 kHz, 54 kHz, S-1604

19. S-1604 is in the 6000-yard position. The pulse out of Q-1627 will be
- a. 12.36 μ sec.
 - b. 74 μ sec.
 - c. 37 μ sec.
 - d. 6.18 μ sec.
20. Linearity is improved in the output sawtooth because of feedback supplied by
- a. C-1632.
 - b. C-1631.
 - c. C-1630.
 - d. C-1633.

- REFERENCES: 1. NAVIRADEV F-2574-1, MAINTENANCE MANUAL 11D13A, DEC 1968, pages 3-17 and 3-18.
2. ELECTRONIC CIRCUIT ANALYSIS, NAVWEAP REPORT 79, 1962, VOL I, Chapter 8, pages 8-38 to 8-47.

INFORMATION:

1. This discussion concerns the operation of a twin-T filter. This filter is sometimes referred to as a band-rejection filter. It has the characteristic of rejecting a narrow band of frequencies. The twin-T filter consists of a high-pass T filter and a low-pass T filter in parallel as illustrated in Figure 1.

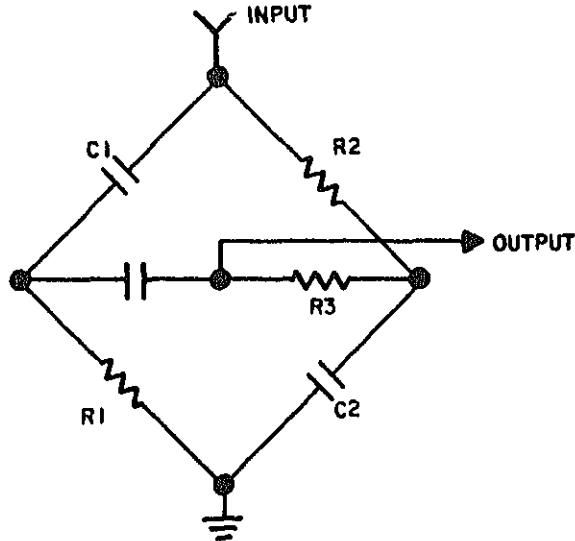


Figure 1

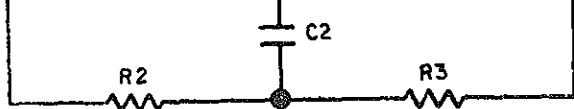


Figure 2

An ideal set of component relationships is chosen to facilitate the analysis but it should be realized that resonance of a frequency can occur for a wide range of component relationships. For purposes of this analysis, we will assume that the following conditions exist at the resonance frequency which we shall call F_r . At F_r , X_{C2} is equal to $R2$, X_{C3} is equal to $R3$, and the values of X_{C3} and $R3$ are very large compared to the values of $R1$ and X_{C1} .

A signal (F_r) applied at the input has two possible paths to travel, $C1-R1$ and $R2-C2$. We shall first consider the path through $R1$. With X_{C1} equal to $R1$, the voltage across $R1$ leads the applied voltage by 45° . The voltage across $R1$ is effectively applied across the network of $C3$, $R3$, and $C2$. Since X_{C3} and $R3$ are very large compared to X_{C2} , the voltage across $R3$ will lead the voltage across $R1$ by 45° . Since X_{C2} is not significant compared to $R3$, the voltage drop across $R3$ can thus be considered the output voltage. Since the voltage across $R1$ leads the input by 45° and the voltage across $R3$ leads the voltage across $R1$ by 45° , the voltage at the output must lead the input by 90° .

(-90° one path, $+90^\circ$ the other path) and will
producing no signal at the output.
frequencies other than F_r , the two signals arriving
output will not be 180° out of phase and thus will not
frequencies close to F_r are highly attenuated, with
less attenuation as the frequency is further and
removed from F_r . For value relationships other than
in this discussion, the analysis is more complex.
input impedance of the Field Effect transistor is
an amplifier to be used with this filter, because
negligible loading effect on the output of the filter.

LESSON TOPIC LEARNING OBJECTIVES:

- 12.5.1 Given a list of statements concerning the function of the transmitter, select the correct statements.
- 12.5.2 Given the 11D13 Maintenance Handbook, the diagram of the transmitter (including the Magnetron and Direct Current Power Supply) and a list of statements concerning the function of the blocks, match the name of the block to its function.
- 12.5.3 Given the 11D13 Maintenance Handbook and Troubleshooting Guide, select from a list the faulty component(s) in the:
- a. Modulator Power Supply
 - b. Transmitter Trigger Generator
 - c. Modulator
 - d. Magnetron Circuits

STUDY ASSIGNMENT:

Read:

1. NAVEDTRADEV P2974-1, Maintenance Handbook, 1968, pp 7-15 through pp 7-18.

STUDY QUESTIONS: NONE

The function of S-103 and S-102 is _____

The function of F-101 and F-102 is _____

The function of T-106 and T-107 is _____

V-101A is a _____ used only when

cycle blocking oscillator is _____

The signal coming on pin 2 of V-101A is a _____

delay _____ microseconds from _____

What action causes V-101B to go into saturation rapidly?

In a free-running condition, the time between out

from V-101B is determined by _____

When pin 3 of T-105 is positive, CR- _____ and C _____ conduct.

The function of C-104 and R-115 is _____

The functions of R-116 and R-119 are _____

V-103 is ionized by +1000 volts on its plate.

a. True.

b. False.

- _____ excite the _____ into
17. The PRF of a driven single-cycle blocking terminated by _____
 18. Pulse width of a single-cycle blocking oscillator is determined by the _____ and _____ the transformer.
 19. The synchronized frequency of a single-cycle oscillator is higher/lower than the free-running frequency. Why?
 20. The driven blocking oscillator operates on _____
 21. A duplexer could be referred to as a/an
 - a. receiving device.
 - b. transmission line.
 - c. electronic switch.
 - d. transmitter

What is the main purpose of a duplexer?

- a. A protection device
- b. Transmission of r-f energy
- c. To increase receiver sensitivity
- d. The use of one antenna for both TX and RX functions

Keep-alive voltage applied to the TR tubes keeps

- a. sufficiently warm.
- b. glowing.
- c. deionized.
- d. near ionization.

When the TR tubes are becoming defective, the first indication will be

- a. loss of minimum-range targets.
- b. loss of maximum-range targets.
- c. smoke coming from the waveguides.
- d. a bright spot on the CRT.

If faulty TR tubes are not recognized and replaced in time enough, this could result in

- a. a defective antenna.
- b. defective and arced waveguides.
- c. weak targets displayed.
- d. no targets displayed.

- b. open.
- c. mismatched.
- d. matched.

29. (Device 11D13) the function of T-103 is to

- a. control peak power out of V-105.
- b. control voltage supplied to T-104.
- c. control voltage supplied to Z-101.
- d. all the above.

30. (Device 11D13) Z-101 is a/an

- a. open-end transmission line.
- b. shorted-end transmission line.
- c. open-end artificial transmission line.
- d. shorted-end artificial transmission line.

31. (Device 11D13) A function of L-101 is to allow charge to approximately

- a. the voltage supplied the PFN.
- b. twice the voltage supplied the PFN.
- c. three times the voltage supplied the PFN.
- d. four times the voltage supplied the PFN.

ice 11D13) V-103 provides Z-101 with a
fast discharge path during transmit time.
fast discharge path during rest time.
slow discharge path during transmit time.
slow discharge path during rest time.

ice 11D13) M-102 monitors

peak current

average current.

peak voltage.

average voltage

ice 11D13) T-102 has a one-to-

one ratio.

two ratio.

three ratio.

four ratio.

ice 11D13) 250 volts is supplied to the modulator
modulator power supply. How much voltage is felt
cathode of V-105 during transmit time?

250 volts.

500 volts.

1000 volts

2000 volts.

c. Z-101 charge current.

d. Z-101 inverse current.

38. (Device 11D13) M-103 monitors

a. output voltage of modulator power

b. voltage supplied to Z-101.

c. V-104 cathode current.

d. PFN charge.

39. Minimum range of a radar set is determined by

a. PW.

b. d-c.

c. PRF.

d. PRT.

40. Maximum range of a radar set is determined by

a. PW.

b. d-c.

c. PRF.

d. PRT.

41. Pulse width of a radar set is determined by

a. synchronizer.

b. PFN.

c. modulator power supply.

d. switch tube.

Increase the output of V-104, you would move the wiper
down on T-103.

True

False

How long is the time delay before 115-volts excitation
is applied to T-106?

What is the purpose of K-101? (Refer to schematic diagram
on P. 53/54.)

Overload protection for the crystal power supply.

Excitation hold-in.

Overload protection for the full-wave power supply.

Overload protection for both power supplies.

LESSON TOPIC LEARNING OBJECTIVES:

- 2.6.1 Given the 11D13 Maintenance Handbook, a block diagram of receiver and a list of statements concerning functions of the blocks, MATCH the name of each block to its function.
- 2.6.2 Given the 11D13 Maintenance Handbook and Troubleshooting Symptoms, SELECT from a list the faulty component in the:
- a. AFC circuits
 - b. IF amplifier circuits
 - c. Video circuits
 - d. Detector circuits

Read: NAVTRADEV P-2974-1 & 2, Maintenance Handbook 11D13A, Dec. 1968, pp 3-6 through 3-10, 7-19

Complete: Student Activity Guide 12.6.1S

STUDY QUESTIONS: NONE

Wave length.

t section of the radar receiver should be rigidly
trolled to maintain a good signal-to-noise ratio?

Second detector.
Local oscillator.
I-F amplifier.
Preamplifier.

ng balanced mixers, a minimum of noise is produce
oss the i-f transformer because

i-f components of noise are out-of-phase.
i-f components of noise are in-phase.
local oscillator components of noise are out-of-
local oscillator components of noise are in-phas

using a balanced crystal mixer in a radar receive
se generated by the _____ is greatly re

magnetron
mixer
klystron
ground return

e the main purpose of the cascode amplifier stage

Decreases noise level.
Amplifies the 30 mc signal.
Sets high signal-to-noise ratio (affecting maxim
range.

conventional pentode amplifiers in a cascade con
n allows a bandpass of _____ by
_____ the plate circuits. (11D13)

t is the function of diode detector (CR 901)? _____

system is to

- a. keep the klystron at the same frequency, re magnetron frequency.
- b. keep the magnetron on frequency.
- c. keep the i-f constant.
- d. provide synchro pulses for the sawtooth generator.

1. The proper output from a discriminator at the reference frequency is

- a. positive pulses only.
- b. negative pulses only.
- c. zero voltage.
- d. positive or negative pulses.

2. In a difference afc system, the sweep to the reference plate will

- a. be below the LO frequency to lock in.
- b. be above the LO frequency to lock in.
- c. always pass through the proper LO frequency.
- d. not lock in unless manually tuned.

3. AFC systems may be classified as either a _____ frequency system or a _____ frequency system.

4. The output of a discriminator depends upon

5. When using the phantastron afc system, at the reference frequency the sweep generator plate swings in a positive or negative direction if the local oscillator is (more/less) than one i-f unit from the transmitter frequency.

Component establishes the predetermined operating
or AGC bias?

Purpose of C-201 and R-219 is for _____
_____.

the purpose of diode CR-201?

Leading edge of the STC wave form represents what?

Components determine the duration of the STC pulse?

Component governs the operating level of the STC pul

- 12.7.1 Given the 11D13 Maintenance Handbook, the and a list of statements concerning the fu the blocks, match the name of the block to
- 12.7.2 Given the 11D13 Maintenance Handbook and 7 Symptoms, select from a list the faulty co in the:

- A. PPI Sweep Generation Circuits
- B. PPI Drive Circuits
- C. Azimuth Maker Generator Circuits
- D. Video Amplifier Circuits

STUDY ASSIGNMENT:

1. Maintenance Handbook, Device 11D13 P-2974-1 & 2, Dec 1968, pp. 2-21 3-54 through 3-61, 4-7, 4-8, and 7-42F.

Complete Student Activity Guide 12.7.1S

STUDY QUESTIONS: None

negative trapezoid.

signals present at TP-1403 and TP-1404 are (1400 u

in-phase.

90° out-of-phase.

180° out-of-phase.

45° out-of-phase.

33 is adjusted for

North-South offset for sweep in BD mode.

North-South offset for sweep in PPI Mode.

East-west offset for sweep in BD mode.

East-West offset for sweep in PPI mode.

y K-1404 is energized in

BD mode.

SEARCH mode.

FC mode.

all modes.

electrical length of the PPI sweep (1400 unit) is
determined by the

electrical position of B-1403.

physical position of B-1403.

pulse amplitude at TP-1402.

pulse duration at TP-1402.

physical length of the PPI sweep (1400 unit) is de
determined by the

electrical position of B-1403.

physical position of B-1403.

pulse duration at TP-1402.

none of the above.

8. The duration of the unblanking pulse to the indicator is determined by:

- a. S-1502A.
- b. S-1502B.
- c. S-1401.
- d. R-1505.

9. The azimuth mark generator's output is displayed

- a. FC and PPI indicator in FC mode.
- b. FC and PPI indicator in BD mode.
- c. FC and PPI indicator in all modes.
- d. PPI indicator in BD only.

10. R-14111 (1400 unit) will vary the intensity

- a. video displayed on the FC and PPI indicators.
- b. video displayed on the PPI indicator only.
- c. azimuth marker displayed on the FC and PPI indicators.
- d. azimuth marker displayed on the PPI indicator only.

11. The slope of the sawtooth out of the sweep generator is determined by the setting of:

- a. S-1502A.
- b. S-1502B.
- c. S-1401.
- d. all of the above.

C1408
R1405
R1437
CR1401

the positive square wave coming out pin 9 J1511 on the A15
produced by what type of circuit?

Schmitt Trigger
Astable Multivibrator
Bistable Multivibrator
Monostable Multivibrator

with the wiper arm (pin 2) of R14108 moved down to pin 3,
missing on the A-Scope?

Fixed Range Marks
Variable Range Mark
Azimuth Mark
Target

R1, CR2, and R9 on the A1404 Board comprise what type of

Nand Gate
Steering Circuit
And Gate
Comparator

R1404 is a _____ diode acting as a _____

15 Volt Zener; Clamper
5 Volt Zener; Limiter
15 Volt Zener; Limiter
5 Volt Zener; Clamper

1434 is used as a _____ adju

B/D East/West Center
PPI East/West Center
B/D North/South Center
PPI North/South Center

- A. PPI is selected
- B. S1407 or S1408 is closed
- C. in Auto-Track Submode
- D. None of the above

20. J1414 pin 6 is an Input to the 1400 Unit when _____

- A. Low power is turned on
- B. Auto-Track Submode is initiated
- C. in F/C Search
- D. in PPI Search

LEARNING OBJECTIVES:

the 11D13 Maintenance Handbook and Trouble Symptom List, select from a list the faulty component(s) in the Radar Track Unit.

the 11D13 Maintenance Handbook, the block diagram and list of statements concerning the functions of the blocks, assign the name of each block to its function for the Radar or submode circuits.

omb Director Mode

Fire Control Automatic Search Submode

Fire Control Acquisition Submode'

Fire Control Automatic Track Submode

ENT:

1. Maintenance Handbook, Device 11D13A, NAVTRADOC P-2974-1, Dec. 1968, pp.3-61-3-73.
2. Aviation Fire Control Technician 3&2, NAVPERC 10-485, pp. 485-489.

Student Activity Guide 12.8.1S

NS: None

- c. used only in bomb director mode.
 - d. applied to the cathode of CR-1926.
2. The output of Q-1907 is
- a. positive and negative range strobes.
 - b. 2 μ sec in duration.
 - c. taraget video.
 - d. one microsecond, negative range stro
3. Maximum current flows through the range
- a. range strobes are present.
 - b. locked-on.
 - c. range strobes are not present.
 - d. the gate diodes conduct.
4. The output of the range track error dete
- a. acceleration.
 - b. range.
 - c. velocity
 - d. distance.
5. Bipolar video is used to
- a. select a target.
 - b. operate coincidence gate.
 - c. range track.
 - d. angle track.

by CR-1906.

the output that controls range circle size is
at J-1907, pin 4.
negative pulses.
from collector of Q-1912.
negative d-c volts.

fire control search sub-mode, K-1903 is
held deenergized by output of Q-1913.
as shown on block diagram.
energized.
not involved.

with no range strobe applied, CR-1901
conducts.
is cut off.
couples the signal.
forward bias's Q-1904.

-1927
conducts until breakaway range is reached.
is an NPN transistor.
is normally forward biased.
conducts when breakaway range is reached.

- d. Q-1907's output is a minimum of
12. For a closing target, the output of
- a. Q-1909 is positive.
 - b. Q-1908 is positive.
 - c. Q-1910 is positive.
 - d. C-1910 is positive.
13. Bipolar video is delayed .3 μ sec by
- a. DL-1901.
 - b. DL-1902.
 - c. inherent circuit delays.
 - d. CR-1907 and CR-1910.
14. Q-1906 functions as
- a. a paraphase amplifier.
 - b. an amplifier.
 - c. a switch.
 - d. an isolation device.
15. Q-1903 is
- a. an emitter follower.
 - b. A C.E. amplifier.
 - c. a switch.
 - d. half of a multivibrator.
16. What is the purpose of Q-1916?

polar video is

used in the TRACK sub-mode.

sent to the indicator display.

created by DL-1902.

used in the SEARCH sub-mode.

the TRACK sub-mode, as range decreases, the

collector of Q-1912 becomes more positive.

emitter of Q-1912 becomes more negative.

range strobe occurs further from the zero.

range strobe occurs closer to time zero.

th target video and the range strobe coincident
t lock on. The possible cause could be

Q-1907 open.

Q-1906 open.

C-1923 shorted.

Q-1904 open.

because of the action of K1901.

C-1923 and C-1925 are utilized in the FIRE CO

C-1923 and C-1925 are utilized in the BOMB DI

C-1922 and C-1924 are utilized in the FIRE CO

c. maximum of 177.1 psec in duration.

24. DL-1901 is used to

- a. delay the video.
- b. shape the video.
- c. delay the range strobe.
- d. shape the range strobe.

24. CR-1901 is

- a. conducting when range strobe is present.
- b. cutoff when range strobe is present.
- c. conducting when video is present.
- d. cutoff when video is present.

26. The waveform observed at J-1906 is

- a. positive, 2 μ sec, at time zero + range +
- b. positive, 1 μ sec, at time zero + range.
- c. positive, 2 μ sec, at time zero + range.
- d. negative, 2 μ sec, at time zero + range.

27. Q-1927 will

- a. saturate at breakaway range.
- b. cutoff at breadaway range.
- c. conduct at acquisition.
- d. cutoff at acquisition.

28. What types of signals are necessary to make and right?

What is the purpose of conical scan?

- 12.9.1 Given the 11D13 Maintenance Handbook, the and a list of statements concerning the functions of the block, MATCH the name of each block to its function.
- 12.9.2 Given the 11D13 Maintenance Handbook and a list of statements concerning the functions of the symbols, MATCH the symbol name to its function.
- 12.9.3 Given the 11D13 Maintenance Handbook and a list of drawings depicting the sequencing and display duration of A-Gun symbols, SELECT the correct drawing.
- 12.9.4 Given the 11D13 Maintenance Handbook and a list of Symptoms, SELECT from a list the faulty component in the:
- 500 Hz Reference Oscillator (A1501)
 - Gate Multivibrator (A1502)
 - Amplifier Gate Generator (A1503)
 - Breakaway Generator (A1505)
 - Range Circle Generator (A1506)
 - Buffer Amplifier (A1510)
 - Vertical Gate (A1507)
 - Horizontal Gate (A1508)
 - Blanking Generator (A1504)
 - A-Gun Driver (A1509)
 - Pedestal Amplifier (P/O A1518)
 - A-Gun Deflection Amplifier (A1520)

STUDY ASSIGNMENT:

Read: Maintenance Handbook Device 11D13A, NAVJAG P-2974-1 and 2.

Complete: Student Activity Guide 12.9.1S

STUDY QUESTIONS: None

Aim dot, artificial horizon, range circle.break
"X", clamp time.
Artificial horizon, range circle/breakaway "X"
dot, clamp time.
Breakaway "X"/range circle, artificial horizon
dot, clamp time.

at is the vertical component of the range circle

500-Hz sinewave leading the reference +45°.
The 500-Hz reference sinewave.
500-Hz sinewave lagging the reference -45°.
A 500-Hz sinewave 180° out of phase with the

en is relay K-1501 energized?

B/D.
PPI.
Lock-on.
Breakaway.

en is relay K-1503 energized?

Lock-on.
Breakaway.
PPI.
B/D.

at is the horizontal component of the horizon 1

500-Hz sinewave in phase with the reference.
500-Hz sinewave lagging the reference -45°.
500-Hz sinewave leading the reference +45°.
500-Hz sinewave 180° out of pahse with the re

at is the A-Gun control grid used for?

Focus.
Astigmatism.
Unblanking.
Deflection modulation.

of the steering and would be deenergized.

- a. always be displayed
 - b. never be displayed
 - c. not be affected
 - d. appear intermittently
9. What is displayed by the A-Gun in the FIR AUTOMATIC TRACK sub-mode?
- a. Artificial horizon line only.
 - b. Artificial horizon line, steering dot
 - c. Range circle, artificial horizon line
 - d. The A-Gun is disabled in this sub-mode
10. Total cycle time for the A-Gun is
- a. 4 ms.
 - b. 8 ms.
 - c. 12 ms.
 - d. 16 ms.
11. Output, pin number 16, gate multivibrator to the
- a. dot gate/circle gate.
 - b. circle gate/horizon line gate.
 - c. horizon line gate/clamp gate.
 - d. dot gate/horizon line gate.
12. A-Gun driver A-1509 is used to
- a. invert the input.
 - b. provide push-pull outputs.
 - c. amplify the input.
 - d. isolation between A-1520 and A-1508/A
13. The frequency of the Wien-bridge oscillator
- a. 1000 Hz.
 - b. 1500 Hz.
 - c. 500 Hz.
 - d. 250 Hz.

- . vertical position.
- . horizontal position.
- . shape.
- . diameter.

he signals needed to produce a circle on an oscilloscope are

- . two sawtooth 90° out-of-phase.
- . two sinewaves 90° out-of-phase.
- . two sawtooth 180° out-of-phase.
- . two sinewaves 180° out-of-phase.

10 (A-1505) is used for

- . balancing of T1 output.
- . biasing of steering diodes CR1-CR2.
- . phase lagging.
- . differentiation.

to what element of the A-Gun is this waveform" applied?

- . Cathode.
- . Horizontal deflection plates.
- . Vertical deflection plates.
- . Control grid.



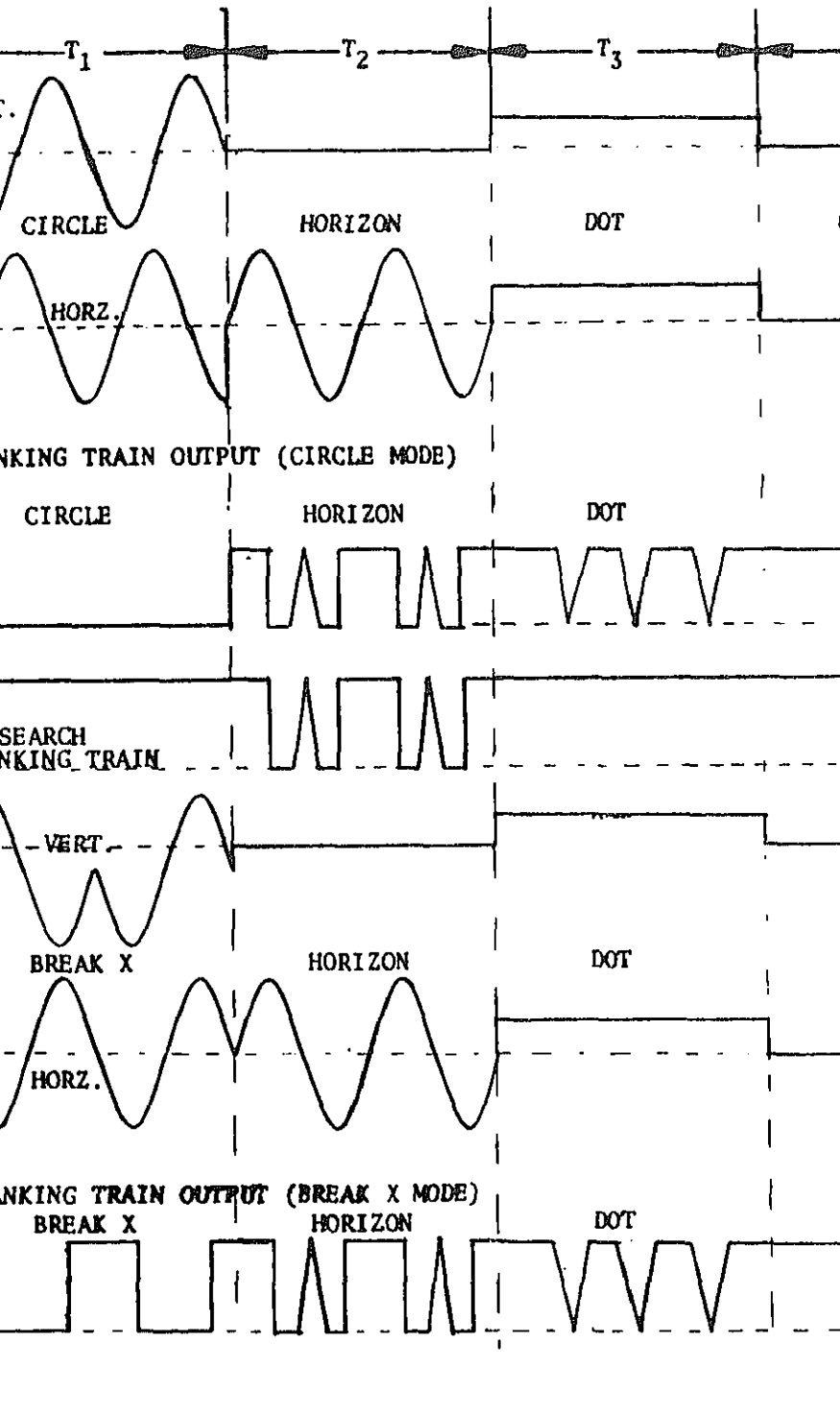
he purpose of the A-Gun portion of the buffer amplifier A-1510 is to

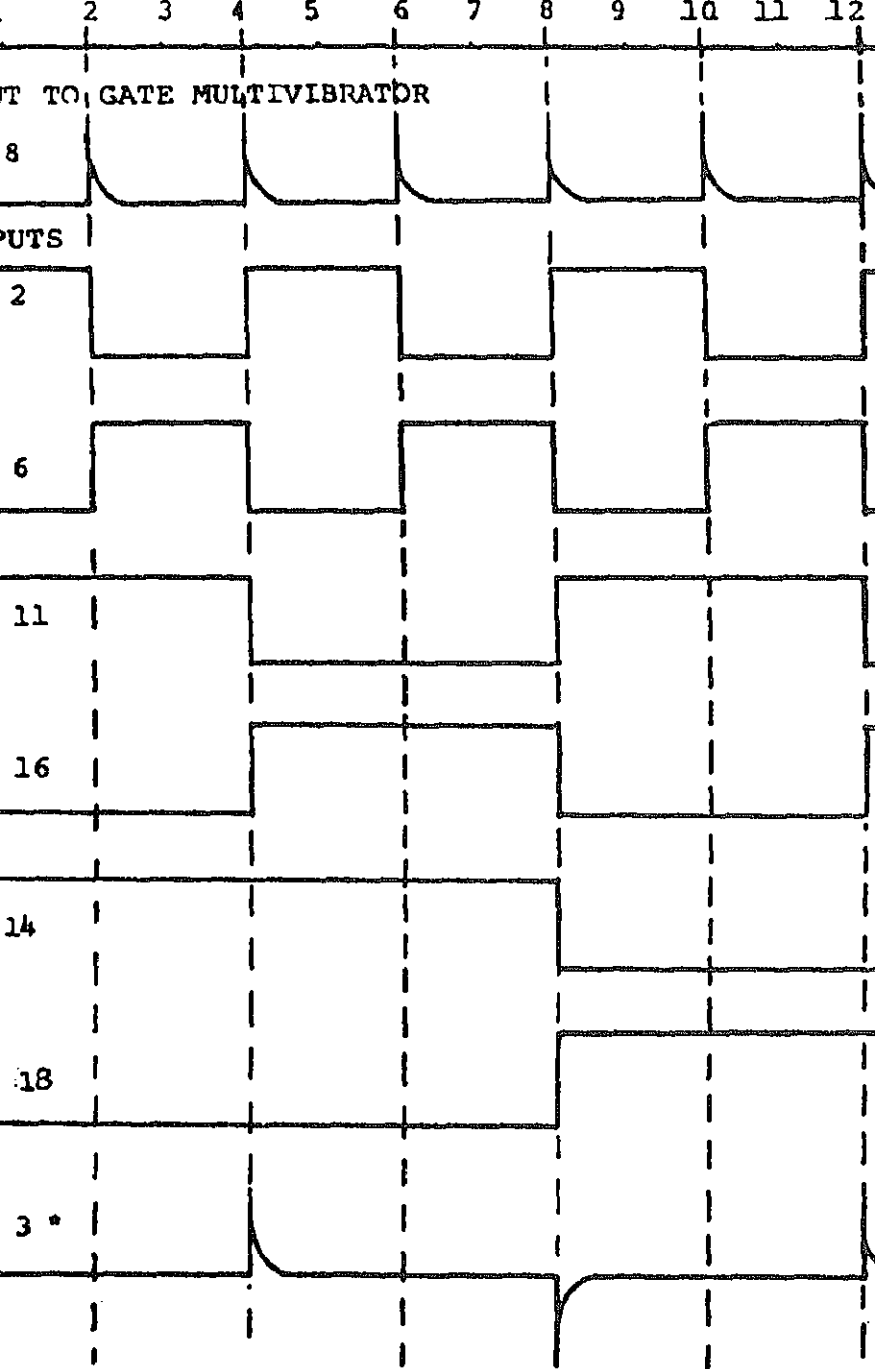
- . gate the A-Gun.
- . amplify the buffer.
- . isolate the antenna from the 1500 unit.
- . apply jizzle to the "B" trace.

he purpose of CR-1 and CR-2 (A-1502) is to

- . couple the negative going swings of Q2's collector to flip-flop #2.
- . limit the incoming signal.
- . clamp the collectors of Q3 and Q4 to ground.
- . provide a d-c bias stabilization reference point.

21. The vertical gate (A-1507) is composed of
- OR gates.
 - NOR gates.
 - AND gates.
 - NAND gates.
22. K-1501 pins 14, 15, and 16 (A-1507) provide for the proper operation of steering diode
- reverse bias.
 - ground.
 - forward bias.
 - an a-c reference
23. The input to steering diodes CR4-CR3 (A-1507) when the aircraft was rolling, would be
- d-c level.
 - \emptyset .
 - pulsating d-c.
 - sinewave.
24. Both inputs to Q4 (A-1507) would be negative
- T_1 .
 - T_2 .
 - T_3 .
 - T_4 .
25. R12 Q3 (A-1509) is adjusted for
- d-c gain balance between Q2 and Q3.
 - +10V d-c.
 - 10V d-c.
 - \emptyset volts.





with A1504 Blanking Generator removed from the circuit.

the 11D13A Maintenance Handbook, the block diagram and a list of statements concerning the functions of the three blocks, MATCH the name of each block to its function.

the 11D13A Maintenance Handbook and a list of statements concerning the functions of the three blocks and the video, MATCH the symbols and video to the function.

the 11D13A Maintenance Handbook and four drawings showing the sequencing and display duration of the symbols, SELECT the correct drawing.

the 11D13A Maintenance Handbook and Trouble Shooting Diagrams, select from a list the faulty component(s) from the following:

Range Sweep Generator (A1511)

Peak detector (A1513)

Acquisition Symbol Generator (A1514)

Horizontal Switch (A1517)

Gun Deflection Amplifier (A1519)

Buffer amplifier (A1510)

pedestal Amplifier (P/O A1518)

10 KHZ Oscillator (A1515)

10 KHZ Multivibrator (A1516)

NOTE:

Maintenance Handbook Device 11D13A, NAVTRADEV P-2974-1&2, PP. 3-42 through 3-52.

Aviation Fire Control Technician 3 & 2, NAVPERC 10387, pp. 478-481.

PI Indicator.
A-gun and B-gun.

anking for the range sweep display is obtained by
ying the range gate from _____ of A-1511 thr
pedestal amplitier to the _____ of the B-gu

pin 2; cathode
pin 9; control grid
pin 2; control grid
pin 9; cathode

sharing for display of the acquisition symbol i
iated by the range gate to pin _____ of th
_____.

5; A-1514
2; A-1514
3; A-1511
2; A-1511

many outputs are there from the 20-KHZ oscillator
515)?

1.
2.
3.
4.

he A-1511 unit, O2 and O3 and associated circuit
up a/an _____ multivibrator.

monostable
bistable
astable
free running

in the A-1519 unit is a

BALANCE control.
CENTERING control.
GAIN control.
TIME control.

- a. blanking the B-gun during range trace time.
 - b. blanking the B-gun during acquisition gate.
 - c. unblanking the B-gun during range trace time.
 - d. unblanking the B-gun during acquisition gate.
9. Q2 of the A-1514 will be cut off
- a. at the end of range sweep time.
 - b. 100 μ sec after range sweep time.
 - c. at time zero.
 - d. 300 μ sec after range sweep time.
10. CR5 of the A-1514 unit will
- a. be conducting when Q4 is cut off.
 - b. be cut off when Q4 is conducting.
 - c. be conducting when Q4 is conducting.
 - d. never be cut off.
11. The amplitude of the signal at pin 9 of A-1516 will determine the
- a. length of the acquisition symbols.
 - b. spacing between the acquisition symbols.
 - c. horizontal position of the acquisition symbols.
 - d. vertical position of the acquisition symbols.
12. The signal at pin 3 of A-1516 is a
- a. 20-KHZ square wave.
 - b. 20-KHZ sine wave.
 - c. 10-KHZ square wave.
 - d. 10-KHZ sine wave.
13. When the acquisition gate is present at pin 1 of A-1517, which of the following conditions exist? (Refer to A-1517 unit.)
- a. CR3 gated on, CR4 gated off.
 - b. CR3 gated off, CR4 gated on.
 - c. CR3 gated on, CR4 gated on.
 - d. CR3 gated off, CR4 gated off.

voltage

proportional to the range selected by the range switch S-1502B.

proportional to the electrical length of the trace.

proportional to the delay between the input trigger and the range strobe.

used to horizontally position the acquisition symbol

acquisition symbol horizontal spacing is determined by

20 KHZ sine wave at pin 7 of A-1515.

20 KHZ sine wave at pin 5 of A-1516.

10 KHZ square wave at pin 3 of A-1516.

20 KHZ square wave at pin 11 of A-1515.

the range strobe appears at pin 5 of A-1513, in which of the following conditions to exist?
()

Q1 conducts, Q2 cut off.

Q1 cut off, Q2 conducts.

Q1 cut off, Q2 cut off.

Q1 conducts, Q2 conducts.

one of the following controls is adjusted so the indicator starts at the bottom of the indicator?

R7 in the A-1511 unit.

R19 in the A-1519 unit.

R4 in the A-1519 unit.

R11 in the A-1519 unit.

many inputs to the A-1515 unit?

None.

1.

2.

3.

synchronizer to trigger the B-gun circuitry

IC LEARNING OBJECTIVES:

Without the aid of notes , define organizational maintenance.

List the steps in the four step fault isolation procedure.

State the purpose for verification of reported discrepancies.

State which step in fault isolation procedure is operational, functional and preflight checks employed.

State the purpose of a spectrum analyzer.

State the purpose of TDR and FDR.

State the purpose of multimeters.

State the purpose of a megger.

State the definition of intermediate maintenance tasks.

List the test equipment normally used in IMA troubleshooting.

List the test equipment normally used in modernization.

State the purpose of warnings in MIMS.

State the purpose of cautions in MIMS.

ASSIGNMENT: Read Information Sheet 12.11.11
Complete Student Activity Guide 12.11.11

REMARKS: NONE

PRODUCTION: The following information sheet will
maintenance level and intermediate
The information below is only basic
coursed in Reference: NAVPERS 103
Control Technician 3&2.

FORMATION:

All the technical knowledge in the world is of
the maintenance of complex systems without a lot
of this knowledge to keep the system in operat
many methods of maintaining these systems as th
cians. However, in many cases these methods ar
arranged to arrive at the necessary conclusions
est efficiency. All of these methods are, to
or in different sequences, a basic four-step me
step method entails:

- a. Verifying that the reported discrepancy does
- b. Isolating the cause of that reported discre
- c. Repairing the cause of that discrepancy.
- d. Rechecking the system to ensure that the d
corrected. This four-step method can be applic
of maintenance.

Organizational Maintenance Activities (OMA)

- A. Verification of the discrepancy at this level
by performing operational and functional checks
all system as installed in an aircraft.
- b. Isolation of the discrepancy is accomplished
voltage checks and continuity of interconn
- c. Repair of the discrepancy at this level of
changing an Aircraft Replaceable Assembly
ing cable repair or replacement of fuses,
- d. Once the repair has been effected, it is ne
system be operationally and functionally c
to ensure that it is in all respects opera

Intermediate Maintenance Activities (IMA)

- a. At this level of maintenance, it is necess

isolate the discrepancy, requires signal tracing (subassembly to subassembly), voltage checks and continuity of chassis wiring.

Once the discrepancy is isolated, the repair of trouble will entail the replacement of a subassembly, the replacement of chassis wiring or the replacement of internal components.

Once again, just as the Organizational level, after a repair has been effected, it is necessary that the aircraft be completely rechecked to ensure proper operation.

The repair is accomplished by the same four-step method as to Organizational and Intermediate Maintenance level scale.

The application of this aforementioned four-step method has been simplified by the layout of Maintenance manuals for particular aircraft or system may be. These manuals contain:

- Introduction to the aircraft or system.

- Equipment lists and locations.

- Fault isolation tables.

- Signal flow diagrams.

- Interconnecting diagrams.

- Wiring diagrams.

- Schematic diagrams.

1. List the technician in the logical troubleshooting process. It is recommended that some form of data sheet such as a checklist be initiated and utilized. These data sheets may be on a printed sheet. This same information can be recorded on paper if necessary, for the purpose of reminding the technician of those checks that have been performed (and those checks which have yet to be performed).

"LEFT BLANK INTENTIONALLY"

ed discrepancy:

leshooting procedure:

erification of discrepancy:

Operational check	Analysis _____
Functional check	
(1) _____	Analysis _____
(2) _____	Analysis _____
(3) _____	Analysis _____

olation to a unit:

Test point taken	Reading observed	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	
_____	_____	

Defective unit _____ P/N _____

ake necessary repairs and/or replacement of unit
roceed to make necessary final adjustments to me
performance standards.

uality Assurance Inspection

Inspector

Date

A. Reported discrepancy:

B. Troubleshooting procedure:

1. Verification of discrepancy:

	Test point taken	Reading observed
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____
e.	_____	_____

2. Isolation to a module/stage:

	Test point taken	Reading observed
a.	_____	_____
b.	_____	_____
c.	_____	_____
d.	_____	_____

Defective module/stage _____

3. Isolation to a component:

- a. Visual inspection
- b. Signal tracing

AN

[illegible]

Analysis

Analysis

ecessary repairs and/or replacement of parts. The
to make necessary final adjustments to meet mini
nce standards.

Date

c. 1400 unit

d. 1600 unit

. During OMA troubleshooting you find there are displayed. There is a faulty output from J14. The most probable failed unit is?

a. 1400 unit

b. 700 unit

c. 1500 unit

d. 1600 unit

. The voltage across pins C and AA, J701 is 185. What reason could be? pg 59/60

a. F 705 open

b. R 736 open

c. CR 701 open

d. Normal operation.

. While isolating to a stage in the 1600 unit you find no output from Q1610. Also there is no output from any other stage. What probable cause would be?

a. Delay multivibrator Q1606, Q1607

b. Schmitt trigger Q1603, Q1604

c. 1-kc reference oscillator Q1601, Q1602

d. Emitter follower Q1605.

The PPI to be disabled.

CR2 on the A1513 board were to open it would c
following?

No blanking of the acquisition symbols

No vertical movement of the acquisition symbols

No horizontal movement of the acquisition symbols

No horizontal movement of the 'B' sweep

possible cause of no range circle being displayed

R15 on the A1501 board fully counter-clockwise

R24 on the A1506 board fully clockwise

R6 on the A1506 board fully counter-clockwise

R17 on the A1506 board fully clockwise

There is 25 VDC on the collector of Q2 of the A15
possible cause could be?

Q2 shorted emitter to collector

R1 A1511 board shorted.

Q3 A1511 board shorted.

R5 A1511 board open.

During an operational check, all PPI indications
in bomb director there is no range cursor and
no vertical movement of the acquisition symbols.
Possible failed unit would be?

1500 unit

1900 unit

1400 unit

1600 unit

No target is being displayed on the indicators, all indications are normal. The most probable cause would be?

- a. V1412 pin 1 open
- b. V1412 pin 2 open
- c. V1413 pins 2 & 9 open
- d. R14111 fully clockwise (pin 2 toward pin 1)

If R1514 were misadjusted, pin 2 toward pin 3. The target would be? pg 71/72

- a. No circle
- b. No break X
- c. No RF lines
- d. No 'A' gun display

In the A1502 board, if Q2 opened what would be fed to the collector of Q.

- a. ground
- b. +28 VDC
- c. 2 MS pulse
- d. 4 MS pulse

In the BD mode of operations there is no depressed target. The most probable cause would be?

- a. K1404 energized.
- b. R1433 out of adjustment
- c. R1434 out of adjustment
- d. Normal operation for BD mode.

DELETED

RODUCTION:

During the study of the 11D13, we have discussed circuits within these units which generate the forms needed in a radar system. It is important be able to check and maintain these typical circuits. The hands-on experience you receive from this lab is to use the necessary test equipment and procedures to troubleshoot the 11D13 trainer.

ON TOPIC LEARNING OBJECTIVES:

- 3.1 With the aid of a job sheet, analyze waveforms from the synchronizer unit.
- 3.2 With the aid of a job sheet, analyze waveforms from the range angle track unit.
- 3.3 With the aid of a job sheet, analyze waveforms from the A-gun.
- 3.4 With the aid of a job sheet, analyze waveforms from the B-gun.
- 3.5 With the aid of a job sheet, analyze waveforms from the A-scope.
- 3.6 With aid of a job sheet analyze the individual modes each mode and submode of operation of the 11D13.

REFERENCES:

1. NAVTRADEV P-2974-1, Maintenance Handbook, Volume 1, Dec., 1968.
2. CNTT-M649, Airborne Radar System Trainer Development schematic diagram.

INSTRUMENTS AND MATERIALS

1. 11D13 Radar Trainer
2. Oscilloscope, Tektronic 453

STEPS:

1. Preliminary Procedure
 - a. Safety

(1) Ensure all watches and rings are removed before working on the trainer.

2. All probes used in this lab and throughout the course must be properly stored and maintained.

(2) Turn on target generator (2300) unit

(a) Set RANGE CONTROL knob to less than yds.

(b) Set TARGET SIZE knob to max.

(c) Do not set ELEVATION CONTROL knob, 1 position found at start of lab.

(d) Do not set TARGET BEARING control knob in position found at start of lab.

(e) All toggle switches in the UP position.

(3) Synchronizer controls (1600)

(a) LOCAL-REMOTE switch to LOCAL position.

(b) RANGE toggle switch (6,000/12,000) 12,000 yd position.

(c) VARIABLE RANGE MARK knob (labeled 1-1000 to 1000 yd position (each number represents times 1000 yds)).

(4) Indicator video controls

(a) SERVO toggle switch to OFF position.

(b) RANGE switch S-1401 (five position switch) 40,000 yd position.

time this switch, S-1401, is changed, the range switch unit must be changed to correspond with it.

(c) VIDEO AMPLITUDE knob R-1411 to max.

(d) RANGE MARK AMPLITUDE R-14108 to max.

(e) SCAN CONTROL switch (toggle type) S-14109 SECTOR position.

(f) SCAN RATE knob (R-1452) to AUTO position.

(g) MODE SELECTOR switch; S-1406, to FC (Foot Control)

- (2) Mode - CHOP
- (3) Sweep time/div. - .2ms
- (4) Horizontal display - A
- (5) A triggering
 - (a) Slope - (+)
 - (b) Coupling - AC
 - (c) Source - Ext.
- (6) A sweep mode - AUTO TRIGGER
- (7) B triggering
 - (a) Slope - (+)
 - (b) Coupling - AC
 - (c) Source - Int.
- (8) Connect coax synch cable between A-trig input and J1603 of trainer

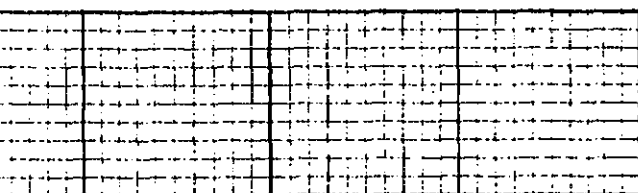
d. STANDBY position must be used when trainer attended.

- (1) Trainer
 - (a) High voltage switch on power supply
 - (b) 1400 unit (indicator video) - SERV
 - (c) 1500 unit (indicator display) - all fully CCW. (down)
 - (d) All modules secured and drawer pushed
- (2) Oscilloscope
 - (a) INTENSITY fully CCW (down)
 - (b) Probes removed from trainer, coils on top of bench.

nsynchronizer (1600 unit)

) Basic trigger

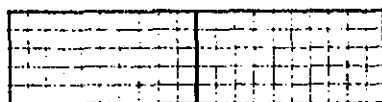
- (a) Connect oscilloscope probe to TP1605 using .2ms/div. and .5 volts/div. (All test points 1600 unit are located on front of unit)
- (b) Adjust R-1603 for a PRF of 1 kHz
- (c) Record adjusted waveform in space provided. Label all waveforms in PRT, amplitude and



TP160

) Output Triggers

- (a) Channel 1 probe to TP-1619, Channel 2 probe to TP1610. Use 2ms/div. and 1 volt/div.
- (b) Adjust R-1625 max CW and record waveform. as before plus delay and pulse width

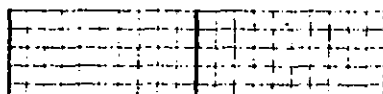


TP161



TP161

- (c) Adjust R-1625 max CCW and record waveform. label as above.



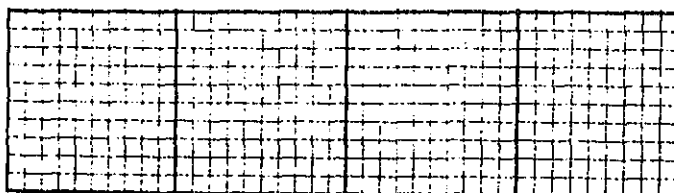
TP161

(3) Ringing oscillator

(a) Connect o-scope to TP1613; channel
.5 volts/div and 20 μ s/div.

(b) Adjustments

1. L-1601 for PRF 161.8kHz (using
2. R-1639 for pulse train flat to
80 μ s. (using 20 μ s/div)
3. Record waveform and label as a



_____ PRT Flat Top _____
Train width _____

_____ Amount delay
front T ϕ Amplitude _____

4. Range Marks

- a. Connect o-scope channel 1
using 20 s/div and .5 volts

8: Remember all voltages must be multiplied by
ten due to the use of 10:1 probes.

- b. Compare the pulse train wave
channel 2 to the range mark
channel 1.

c. VRM minimum range (variable

- 1) R-1667 (VRM Pot.) set
painted numbers around
- 2) Adjust R-1668 to coincide
pulse, or max CW if VRM
reach second pulse.

with 7th pulse.

e. S-1602 (RANGE MARK INTERNAL switch
1000 yds,

1) Measure and record PRT

_____ 1000

f. S-1602 to 2000 yd position

1) Measure and record PRT

_____ 2000

g. S-1602 to 3000 yd. position

1) Measure and record PRT

_____ 3000

5. Doppler circuits

a. Set o-scope

1) Channel 1 to TP1623, use 200
1 volt/div

2) Channel 2 to TP1622, use 200
1 volt/div.

b. R-1667 to 1000 yds

1) Record waveform, amplitude
width at TP1623 and TP1622
measure only the delay for

000 yds



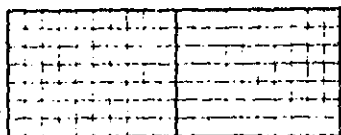
TP1623 PW _____



TP1622 PW _____



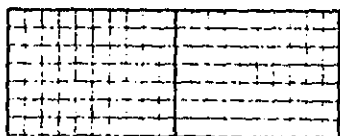
- 1) Record waveform and m width



TP1627 P

f. R-1667 to 12000 yds.

- 1) Record waveform and m width at TP1627.

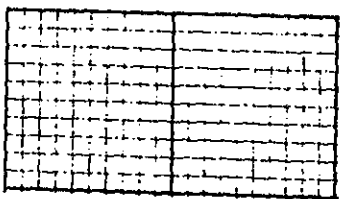


TP1627 P

- a) Note: The change waveform compared channel 2.

g. RANGE switch (S-1604) to

- 1) Record and measure wa



TP1627 P

- a) Vary R-1667 from yds and note the l's waveform com channel 2.

- b) Note: The chang between TP1627 i position and TP1 yd position.

b. Why is there a delay before the oscillator starts oscillating? Does the ringing oscillator's train eventually become?

c. Why is the VRM adjusted to the mark for minimum and the 13th minimum in the 12,000 yd range position?

Instructor Verification: _____
In

PPI circuits (planned position indicator)

(1) Preliminary procedure - indicator units

(a) 12,000 yd. range on 1400 unit and 1500 switches. (S-1401 & (S-1502)

(b) SCAN CONTROL switch (S-1405) to PPI position

(c) HIGH VOLTAGE switch (power supply; 700V)

(2) Laboratory experiment.

(a) Sweep deflection N-S.

1. O-scope set up

a. .1ms/div.

- a. PPI INTENSITY UP so sweep is visible on scope.
- b. AUTO/MAN scan select switch to MAN (1400 unit)
- c. SERVO switch (1400 unit) to ON
- d. Adjust sweep to 0° by turning SC control knob left or right until at the top of scope and centered
- e. Turn SERVO switch (1400) OFF
 - 1) Sweep should now be centered stationary.

3. Adjust R-1433 so that last (fourth position) fixed range mark is just visible at top of CRT mask.
4. Adjust R-1418 so that channel 1 and waveforms are identical in shape.

(b) Sweep deflection E.W.

1. Set sweep position on "A" scope manual to 90° . (Follow same procedure as used to 0°)
2. O'scope
 - a. Channel 1 to TP1405
 - b. Channel 2 to TP1406
3. Adjust R-1476 so that signals at TP1405 and TP1406 are identical in shape.
4. Adjust R-1479 so that the sweep (on O'scope) is centered and extends so that the range mark is just visible at edge of scope
5. Record waveforms at TP1403 and TP1406

TP1403 Amplitude _____

PRT _____

1. Reset sweep position (on "A" s
2. Select range mark interval for
3. Adjust R-1401 so the 12th range edge of mask.
4. Reset sweep position to 90°
5. Adjust R-1451 so that 12th range edge of mask (do not count the scope as a range mark)

(d) BD MODE (Bomb Director)

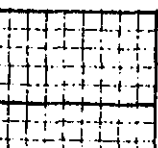
1. Controls

- a. Set RANGE at 40,000 yds. (must be selected on 1400 a
- b. BD AZIMUTH MARKER control ed position
- c. SCAN CONTROL switch to SEC
- d. MODE SELECT switch to BD.

2. Adjust R-1434 so the sweep sta of scope.

3. Waveforms

- a. Channel 1 probe to TP1402
- b. Remove channel 2 probe fro
- c. Set o-scope to 2 volts/div
- d. Observe waveforms in all f positions (in 80,000 yd p o-scope to 5 volt/div and
- e. Record waveforms for each measure amplitude and swee

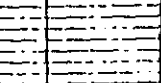


6000 yds

Amp _____

Duration _____

12000 yds

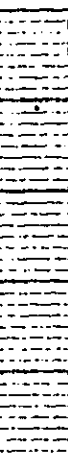


80,000 yds
(5v/Div)

Duration _____
Amp _____
Duration _____

NOTE: Bomb director mode not used for 12,000 yd position only 10,000 yd and 80,000 yd positions. When training use 40,000 yd position. Note that the 10,000 yd and 80,000 yd positions are in 6000 yds and 12,000 yd positions only.

- (e) Repeat above observation, measurement for FC Mode. (Change MODE SELECT switch to FC). Reset O-scope to 2 volts/Div.



6,000 yds

Amp _____
Duration _____

12,000 yds

Amp _____
Duration _____

10,000 yds

Amp _____
Duration _____

40,000 yds

Amp _____
Duration _____

80,000 yds

Amp _____
Duration _____

Instructor Verification _____

c. Range/Angle Tracking (1900 unit)

(1) Preliminary procedures

- (a) Place trainer in FIC mode, 40,000 yds

(2) Laboratory assignment (The 19000 unit with power removed.) Make no adjustments on

- (a) Observe TP1934 (set o-scope to 20 μ s, 2 volts/div.)

PW _____

Amplitude _____

Observe TP1924

Measure sweep duration and record

Switch to BD mode, measure sweep duration and record

BD _____

FC _____

Reselect FC Mode

Change integrator output

Go to TP1910

a. Set o-scope to DC input, 1 volt/div.

b. Turn R-1461 fully CCW. (0 yds)

c. Measure and record DC level

d. Turn R-1461 slowly CW and observe change in DC level. When fully CW measure and record DC level. (Fully CW equals 40,000 yds)

Lock-on (acquisition)

Lock trainer on to target video by placing acquisition symbols over target (Note: Acq. symbols may have to be placed slightly above or below target in order to lock on).

Observe waveform at TP1927

Turn RANGE RATE toggle switch on 2300 unit down. (First-center switch on left)

Radar should track down in range (Note change in waveform).

Break-X should appear when radar has tracked to 3500 yds.

A12

A18

A19

2. Adjustments

- a. Channel 1 to F6 (.2ms/div and .2 volts/div)
- b. Adjust R-15 fully CCW
- c. A1503 adjust R-19 for a 1ms positive pulse width. (Replace A1504 and A1503 for adjustment, then replace and drop A1504).
- d. A1504 adjust R-15 CW until a/.1ms appears in the positive pulse. (It will be necessary to go to .1ms/div to adjust accurately).
- e. Using procedure in step c. drop A1504 adjust R-6 until gap is centered positive pulse (use .2ms/div.)
- f. Replace board (DO NOT HAVE TWO DO AT ONCE)
- g. A1504 1" Channel 1 (REF) 2ms/div .2V/div.
- 1) Record and label ALL parts (PC BOARD, CPU, AMP)

2) Replace A1507 board and group A1500-

i. A1508 (Horizontal Gate)

- 1) Attached channel 2 probe to A4
- 2) Record same as above

A1504 F5

A1507 A4

A1508 A4

j. Replace Board and break lockon.

k. Answer the following conclusions:

- 1) Why is the output of R-15 pin 2 adjusted (1v pp) to less amplitude than P17 (9 v pp) on the A1501 Board?
- 2) What caused the positive pulse at A1504 A18?
- 3) Why did adjusting A1503 R-6 center GAP of the blanking signal?

Instructor Verification:
Initials

(a) Drop A1511 board down (Range Sweep

CAUTION: Ensure power switches are in OFF position
down or putting up boards.

1. Attach o-scope probe to D18 (a
2. Adjust R-7 to set rise time (R
3. Put A1511 board back up.

(b) Drop A1515 board down (20kHz oscil

1. Set o-scope to .2 volts/div
2. Trigger source to INTERNAL
3. Synch by adjusting trigger level
probe attached
4. Attach probe to C11
5. Adjust R-13 so that signal is
6. Put A1515 board up.

(c) Drop A1517 board (Horizontal switc

1. Set FC sector center to ZERO
2. Set servo switch to ON
3. Set R-1460 (azimuth hand control)
degrees.
4. Adjust R-6 to position range
(B-scope) to zero degrees while
depressed (this puts trainer
5. Adjust R-19 to position acquisition
range sweep.
6. Depress P-1460 and turn fully
7. Adjust P-16 to position acquisition
range sweep (while holding P-

2. Adjust R-19 until the length of range sweep just fills mask.
3. Turn azimuth servo ON
4. Adjust R-11 so that range sweep horizontal travel goes to edge of mask left and right
5. Put A1519 board back in up position.

Drop a A1516 board (10kHz Oscillator)

1. Adjust R1 so acquisition symbols are visible and not overdriven. (R1 is an amplitude adjust that controls intensity of acquisition symbols.)
2. Replace A1516 in up position

Drop A1515 board (20kHz Oscillator)

1. Adjust R-12 (phase shift adjust so that acquisition symbols have proper blanking (no bow tie).
 2. Adjust R-13 so that acquisition symbols are approximately half an inch in length (vertically)
- E: If there is only one acquisition symbol adjust R-2 so there are two.

3. Put A1515 board in up position.

Adjust R-1545 for a balance between range sweep intensity and acquisition symbol intensity (R-1545 is located on the bottom of 1500 unit center line rear. Ensure the proper resistor is adjusted. Numbers are in front of the pot.

Drop A1511 board (Range Sweep Gen)

1. Adjust R-1461 MANUAL RANGE CONTROL CW (40,000 yds)

sweep is visible and stationary (center).
tor).

3. Replace A1511 in up position.

(i) Drop A1513 board (PEAK DETECTOR)

1. Adjust R-1461 fully CCW (zero yds)

2. Adjust R-3 so that acquisition symb
at bottom of scope. (zero adjust)

NOTE: The two prior adjustments may have to be
since they interact.

3. Replace A1513 board in up position

(j) Deflection waveforms FC search

1. Set o-scope to .1ms/div and 5 volt

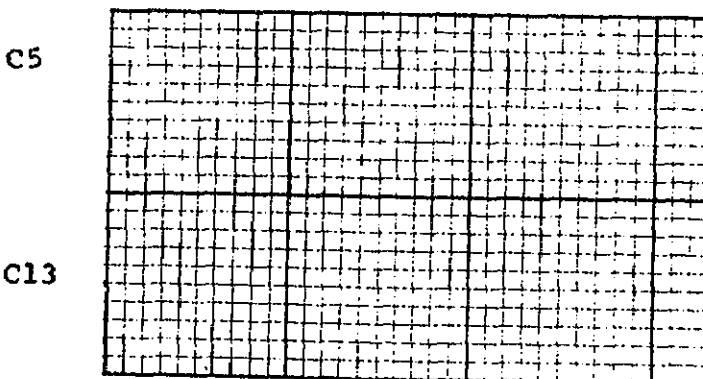
2. SYNCH to EXTERNAL

3. Drop A1519 board (B-Gun Deflection

4. Channel 1 to C5 (vertical deflecti

5. Channel 2 to C13 (horizontal defle

6. Record waveforms and label all par



7. Replace A1519 board in up position

(k) Blanking waveform FC search

F20

4. Replace A1518 board in up position

) Deflection waveforms FC track

1. Lock trainer onto a target (puts trainer in FC track)

2. Drop A1519 board

3. Channel 1 to C5

4. Channel 2 to C13

5. Record and label all parts.

C5

C13

6. Replace A1519 in up position

) Unblanking waveform FC track

1. Drop A1518 board

2. Channel 1 to F20

3. Record waveform and label all parts

F20

3. What characteristic of the ac does the amplitude of the 10k determine?

Instructor Verification

f. Functional Check Scope presentations

(1) PPI search mode

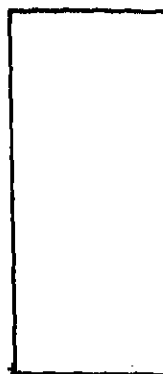
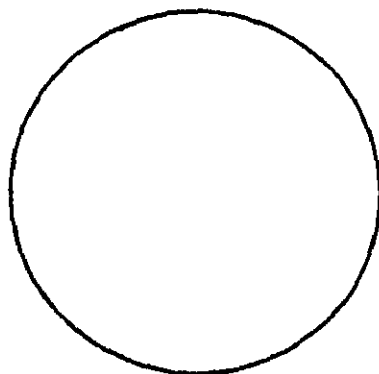
(a) Controls

1. 12000 yd range
2. Scan-AUTO PPI
3. Mode FC
4. TGT Range from 2300 unit betw

- (b) Observe the scope presentation and all parts for each presentation.

PPI

A-scope

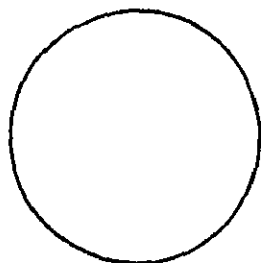


3. Mode - BD

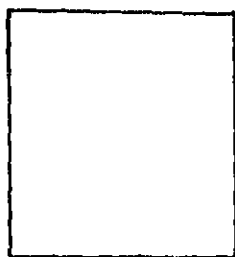
4. Target range - less than 20,000 yds.

5. Range cursor close to target.

(b) Observe and record presentation. Label all



A-scope



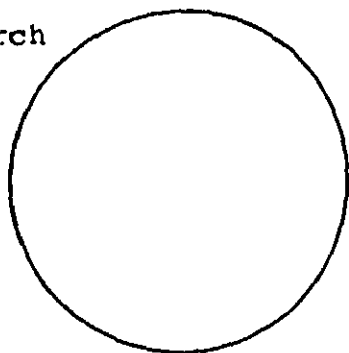
B-scope

4) FC Mode (Search)

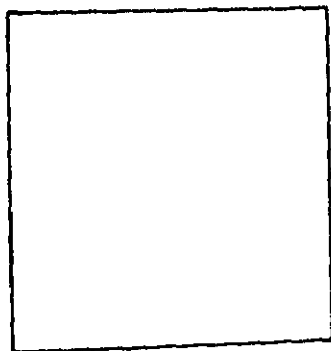
(a) Controls - same as BD except mode switch to

(b) Observe and record presentations. Label all

arch



A-scope



B-scope

4) FC Mode track (Circle Submode)

(a) Controls same as search mode.

(b) Acquire and lock on target.



A-scope



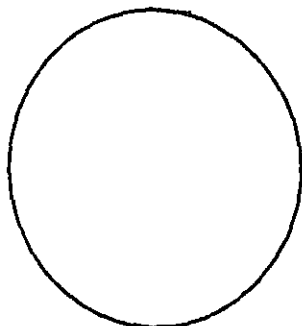
B-scope

(5) FC Mode track (break X submode)

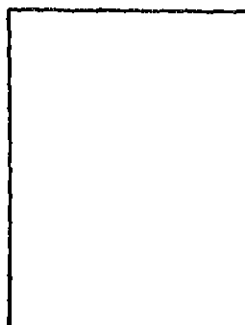
(a) Controls

1. Same as above except, turn range switch down. (RATE)

- (b) Observe presentation as trainer track down in range when break away occurs presentations.



A-scope



B-Scope

Breakaway occurs

(6) Conclusions

- (a) What does B-scope presentation represent in BD Mode?

IS:

important for the sweeps on the scope to start at the transmitter fires?

he PPI indicator blanked?

width of the range strobe can be varied by what c

he bias input to the 500Hz oscillator used for?

oscillator (A-1515) is what type of oscillator?

isplayed by the A-GUN in PC track?

Instructor Verification

Initial

OPIC LEARNING OBJECTIVES:

Given 11D13 Maintenance Handbook and trouble s
select the proper test equipment and locate th
unit, module or component(s) in the 11D13 Rada
Document maintenance actions and follow approp
precautions.

Given the 11D13 Maintenance Handbook, verify t
malfunction by performing operational checks o
trainer. Record all malfunctions on the job s

Given the 11D13 Maintenance Handbook, locate t
unit by utilizing signal tracing, spectrum ana
voltage and continuity measurements as require

Simulate system repair at OMA level by orderin
ceiving new unit on VIDS MAF. Utilize student
obtain codes required on VIDS MAF.

Given the 11D13 Maintenance Handbook, verify p
operation (malfunction corrected) by performin
checks on the radar trainer.

Given the 11D13 Maintenance Handbook, locate t
module by utilizing signal tracing, voltage an
measurements as required.

Simulate unit repair at IMA level by ordering
new module on VIDS MAF. Utilize students guid
codes required on VIDS MAF.

Given the 11D13 Maintenance Handbook, verify
operation (malfunction corrected), by perform
operational checks required to check the unit
paired.

Given the 11D13 Maintenance Handbook, locate
component(s) by utilizing signal tracing, vol
tunity measurements as required.

0 Simulate module repair at IMA level by orderi
ceiving new component(s) on VIDS MAF. Utiliz
guide to obtain codes required on VIDS MAF.

Additional checks required to check the module repaired.

NAVTRADEV, p-2974-1&2 Maintenance Handbook Dev
December 1968.

Materials: Training Device 11D13

ional check

urn low voltage on; on power supply

ays turn the low voltage on first and listen fo

urn on high voltage.

urn on target generator

ode check

etup for PPI mode

1) Turn 1400 servo switch on.

2) Place 1400 range switch in 12,000 yd rd rang

3) Place PPI-Sector switch in PPI.

4) Place 1500 range switch in 12,000 yard range

5) Adjust PPI intensity and focus controls for
display.

heck PPI display for proper indications as show

ocument Indications presented on scope, using a

(3) Place B/D -FIC switch on 1400 unit to B

(4) Place 1500 range switch to 40,000 yards

(5) Adjust 1500 unit control for proper scope

b. Check B/D display for proper indications as

A-scope

B-scope

c. Document indications presented on scope, using forms.

Instructor initials

4. F/C Mode

a. Set up for F/C mode

(1) Place B/D-FIC switch on 1400 to FIC

(2) Adjust 1500 controls for proper display

b. Check FIC auto search for the following indications

A-scope

B-scope

Instructor initials _____

- e. To get to breakaway X submode, place the range switch on the 2300 unit to the down position.
- f. Check the breakaway X submode for the following:

- g. Document indication presented on scope using the following forms.

Instructor initials _____

If the indications are bad (1 or all) then do the following for OMA

- a. OMA

(1) Isolate to a unit documenting all necessary information

- (3) Isolate to a component by signal tracing, readings and resistance readings and document
- (4) Order IMA part documenting proper paperwork
- (5) Sign off IMA MAF

Instructor initials _____

ST ITEMS:

What range should be selected for the FIC mode?

Where are the intensity controls located (unit#)?

What is the proper sequence for turning power on?

Instructor initials _____

0		
0		
7		
6		
7		
6		
3		